CLAIMS

What is claimed is:

1. A method for increasing the channel data rate throughput in an optical fiber communication system while minimizing a bit error rate, the method comprising the steps of:

receiving a digital input signal, comprising a series of input pulses, each input pulse having one of two pulse levels ;

creating a digital input word having *n* bits from the digital input signal;

converting each digital input word to a corresponding output symbol representing one of 2^n distinct values;

generating an output signal comprising a series of output symbols; and

modifying a first output symbol, according to a signal property of a preceding output symbol and a signal property of a succeeding output symbol.

2. The method of Claim 1, wherein the step of modifying the first output symbol comprises accessing a look-up table to determine an appropriate modification of a signal property of the first output symbol.

3. The method of Claim 1, wherein the step of modifying the first output symbol is performed by a precompensation circuit.

4. The method of Claim 1, wherein the digital input signal is received from *n* separate channels, the output signal having *n* times higher data rate than that of one of the *n* separate channels.

5. The method of Claim 1, wherein the digital input signal is received from a single channel.

6. The method of Claim 1, wherein the spectral occupancy of the optical signal is minimized.

7. The method of Claim 1, wherein the signal property of the preceding output symbol is a first amplitude and the signal property of the succeeding output symbol is a second amplitude and further comprising the step of interrogating the output signal to determine an amplitude of the first output symbol.

8. The method of Claim 7, further comprising the step of interrogating the output signal to determine the amplitude of the preceding output symbol.

9. The method of Claim 7, further comprising the step of interrogating the output signal to determine the amplitude of the succeeding output symbol.

10. The method of Claim 7, wherein the first output symbol, is delayed to determine the amplitude of the succeeding output symbol.

11. The method of Claim 10, wherein a transmission line is used to delay the first output symbol for a first delay time.

12. The method of Claim 10, wherein a digital register is used to store the first output symbol, thereby delaying the first output symbol for a first delay time.

13. The method of Claim 7, wherein the preceding output symbol, is delayed to determine the amplitude of the first output symbol.

14. The method of Claim 13, wherein a transmission line is used to delay the preceding output symbol for a second delay time.

15. The method of Claim 13, wherein a digital register is used to store the first output symbol, thereby delaying the first output symbol for a first delay time.

16. The method of Claim 1, wherein the step of modifying the first output symbol comprises modifying an amplitude of the first output symbol.

17. The method of Claim 16, wherein the step of modifying the amplitude of the first output symbol comprises modifying the amplitude of the first output symbol based on the amplitude of the first output symbol.

18. The method of Claim 16, wherein the step of modifying the amplitude of the first output symbol comprises modifying the amplitude of the first output symbol based on the preceding output symbol.

19. The method of Claim 16, wherein the step of modifying the amplitude of the first output symbol comprises modifying the amplitude of the first output symbol based on the amplitude of the succeeding output symbol.

20. The method of Claim 16, wherein the step of modifying the amplitude of the first output symbol comprises modifying the amplitude of the first output symbol based on the phase of the first output symbol .

21. The method of Claim 16, wherein the step of modifying the amplitude of the first output symbol comprises modifying the amplitude of the first output symbol based on the phase of the preceding output symbol.

22. The method of Claim 16, wherein the step of modifying the amplitude of the first output symbol comprises modifying the amplitude of the first output symbol based on the amplitude of the succeeding output symbol.

23. The method of Claim 1, further comprising the step of further modifying the first output symbol, according to an amplitude of a second preceding output symbol and a second succeeding output symbol.

24. The method of Claim 1, wherein the signal property of the preceding output symbol is a first frequency, the signal property of the succeeding output symbol is a third frequency and the signal property of the succeeding output symbol is a second frequency and further comprising the step of interrogating the output signal to determine a frequency of the first output symbol.

25. The method of Claim 24, wherein the step of modifying the first output symbol comprises modifying the frequency of the first output symbol.

26. The method of Claim 25, wherein the step of modifying the frequency of the first output symbol comprises modifying the frequency of the first output symbol based on the frequency of the preceding output symbol. The method of Claim 22, wherein the step of modifying the frequency of the first output symbol comprises modifying the frequency of the first output symbol based on the frequency of the succeeding output symbol.

27. The method of Claim 22, wherein the step of modifying the frequency of the first output symbol comprises modifying the frequency of the first output symbol based on the frequency of the first output symbol.

28. The method of Claim 1, wherein the signal property of the preceding output symbol is a first phase and the signal property of the succeeding output symbol is a second phase and further comprising the step of interrogating the output signal to determine a phase of the first output symbol.

29. The method of Claim 28, wherein the step of modifying the first output symbol comprises modifying a phase of the first output symbol.

30. The method of Claim 29, wherein the step of modifying the phase of the first output symbol comprises modifying the phase of the first output symbol based on the phase of the first output symbol.

31. The method of Claim 29, wherein the step of modifying the phase of the first output symbol comprises modifying the phase of the first output symbol based on the phase of the succeeding output symbol.

32. The method of Claim 29, wherein the step of modifying the phase of the first output symbol comprises modifying the phase of the first output symbol based on the phase of the preceding output symbol.

33. The method of Claim 29, further comprising the step of further modifying the first output symbol, according to a phase of a second preceding output symbol and a phase of second succeeding output symbol.

34. The method of Claim 29, wherein the step of modifying the phase of the first output symbol depends upon the amplitude of the preceding output symbol.

35. The method of Claim 29, wherein the step of modifying the phase of the first output symbol depends upon the amplitude of the succeeding output symbol.

36. The method of Claim 29, wherein the step of modifying the phase of the first output symbol depends upon the amplitude of the first output symbol.

37. A method for increasing the channel data rate throughput in an optical fiber communication system while minimizing a bit error rate, the method comprising the steps of:

receiving a digital input signal, comprising a series of input pulses, each input pulse having one of two pulse levels;

creating a digital input word having n bits from the digital input signal; converting the digital input word to an error resistant digital input word;

converting each error resistant digital input word to a corresponding error resistant output symbol having one of 2^n distinct values;

generating an output signal comprising a series of error resistant output symbols; and

transmitting each error resistant output symbol to a receiver over a fiber optic link.

38. The method of Claim 37, wherein the digital input signal is received from n separate channels, the output signal having n times higher data rate than that of one of the n separate channels.

39. The method of Claim 37, wherein the digital input signal is received from a single channel.

40. The method of Claim 37, wherein the error resistant output symbol is convolutionally coded.

41. The method of Claim 37, wherein the error resistant output symbol is encoded with block coding.

42. The method of Claim 37, wherein the error resistant output symbol is encoded with trellis coding.

43. The method of Claim 37, wherein the error resistant code is a Gray code.

44. The method of Claim 43, wherein the Gray code is characterized by having adjacent words that are differentiated from each other by a change in only one bit.

45. The method of Claim 37, wherein the error resistant code is a Q-Gray code.

46. The method of Claim 45, wherein the Q-Gray code is characterized by having adjacent words that are differentiated from each other by a change in only one bit.

47. A method for increasing the channel data rate throughput in an optical fiber communication system while minimizing a bit error rate, the method comprising the steps of:

receiving a digital input word having *n* bits;

converting the digital input word to an error resistant digital input word;

converting each error resistant digital input word to a corresponding error resistant output symbol representing one of 2^n distinct values; and

transmitting each error resistant output symbol to a receiver over a fiber optic link.

48. A method for increasing the channel data rate throughput in an optical fiber communication system, the method comprising the steps of:

receiving a digital input signal, comprising a series of input pulses, each input pulse having one of two pulse levels;

creating a digital input word having *n* bits from the digital input signal;

converting each digital input word to a corresponding output symbol having one of 2^n distinct values;

generating an output signal comprising a series of output symbols;

adding a signal dependent bias to the output signal so that a linear response is generated in the optical source; and

using the optical source to transmit the output signal.

49. The method of Claim 48, wherein the digital input signal is received from *n* separate channels, the output signal having *n* times higher data rate than that of one of the *n* separate channels.

50. The method of Claim 48, wherein the digital input signal is received from a single channel.

51. The method of Claim 48, wherein error correction coding is applied to the input data.

52. The method of Claim 48, wherein a drive current controls the optical source.

53. The method of Claim 48, wherein the step of adding a signal dependent bias comprises changing the drive current associated with the output signal by an error current.

54. The method of Claim 52, wherein the drive current controls a laser diode.

55. The method of Claim 54, wherein a nonlinear element is used to shunt an error current from the drive current.

56. The method of Claim 55, wherein the laser diode is a nonlinear optical modulator device.

57. The method of Claim 48, wherein a drive voltage controls the optical source.

58. The method of Claim 57, wherein a series resistor is used to convert a nonlinear shunt current into a nonlinear voltage drop to reduce the drive voltage.

59. The method of Claim 57, wherein the step of adding a signal dependent bias comprises adjusting the drive voltage associated with the output signal by an error voltage.

60. The method of Claim 52, wherein the drive controls a Mach-Zehnder modulator.

61. The method of Claim 60, wherein a series resistor is used to convert a nonlinear shunt current into a nonlinear voltage drop to reduce the drive voltage.

62. An optical transmitter for generating an optical fiber communication signal for transmission over an optical fiber while minimizing a bit error rate, the optical transmitter comprising:

a symbolizer for receiving an input data signal comprising a series of pulses, each pulse having one of two distinct pulse levels, wherein the symbolizer is operative to convert n pulses from the input data signal into an error resistant n-bit output word, and further operative to generate an output symbol representing one of 2^n distinct values; and

an optical source for transmitting an output signal comprising at least one error resistant output symbol over the optical fiber, each error resistant output symbol corresponding to one of 2^n optical source intensity levels.

63. The optical transmitter of Claim 61, wherein the input data signal is received from n separate channels, wherein the output signal comprises n-times higher data rate than the n separate channels.

64. The optical transmitter of Claim 61, wherein the input data signal is received from a single channel.

65. The optical transmitter of Claim 61, wherein the error resistant output symbol is convolutionally coded.

66. The optical transmitter of Claim 61, wherein the error resistant output symbol is encoded with trellis coding.

67. The optical transmitter of Claim 61, wherein the error resistant output symbol is encoded with block coding.

68. The optical transmitter of Claim 61, wherein the error resistant code is a Gray code.

69. The optical transmitter of Claim 68, wherein the Gray code is characterized by having adjacent words that are differentiated from each other by a change in only one bit.

70. The optical transmitter of Claim 61, wherein the error resistant code is a Q-Gray code.

71. The optical transmitter of Claim 70, wherein the Q-Gray code is characterized by having adjacent words that are differentiated from each other by a change in only one bit.

72. A transmission link for transmitting an optical fiber communication signal for transmission over an optical fiber, the optical transmission link comprising:

a symbolizer for receiving an input data signal comprising a series of pulses, each pulse having one of two distinct pulse levels, wherein the symbolizer is operative to convert *n* pulses from the input data signal into an error resistant *n*-bit output word, and further operative to generate an output symbol representing one of 2^n distinct values; and

an optical source for transmitting an output signal comprising a series of the optical symbols over the optical fiber, each optical symbol having one of 2^n intensity levels; and

wherein the symbolizer is further operative to modify a signal property of each optical symbol, according to a signal property of a preceding optical symbol and a signal property of a succeeding optical symbol.

73. The transmission link of Claim 71, wherein the input data signal is received from *n* separate channels, wherein the output signal comprises *n*-times higher data rate than the *n* separate channels.

74. The transmission link of Claim 71, wherein the digital input signal is received from a single channel.

75. The transmission link of Claim 71, wherein the symbolizer further comprises a predistortion circuit.

76. The transmission link of Claim 74, wherein the predistortion circuit is further operative to interrogate the output signal to determine the signal property of the first output symbol.

77. The transmission link of Claim 74, wherein the predistortion circuit is further operative to interrogate the output signal to determine the signal property of the preceding output symbol.

78. The transmission link of Claim 74, wherein the predistortion circuit is further operative to interrogate the output signal to determine the signal property of the succeeding output symbol.

79. The method of Claim 74, wherein the predistortion circuit performs the function of accessing a look-up table to determine an appropriate modification of the transmitted optical symbol.

80. The transmission link of Claim 74, wherein the signal property of the first output symbol is an amplitude of the first output signal and the predistortion circuit is further operative to modify the first output symbol by modifying the amplitude of the first output symbol.

81. The transmission link of Claim 80, wherein the predistortion circuit is further operative to modify the amplitude of the first output symbol based on the amplitude of the first output symbol.

82. The transmission link of Claim 80, wherein the predistortion circuit is further operative to modify the amplitude of the first output symbol based on the amplitude of the succeeding output symbol.

83. The transmission link of Claim 80, wherein the predistortion circuit is further operative to modify the amplitude of the first output symbol based on the amplitude of the preceding output symbol.

84. The transmission link of Claim 74, wherein the signal property of the first output symbol is a phase of the first output signal and the predistortion circuit is further operative to modify the first output symbol by modifying the phase of the first output symbol.

85. The transmission link of Claim 84, wherein the predistortion circuit is further operative to modify the phase of the first output symbol based on the phase of the first output symbol.

86. The transmission link of Claim 84, wherein the predistortion circuit is further operative to modify the phase of the first output symbol based on the phase of the succeeding output symbol.

87. The transmission link of Claim 84, wherein the predistortion circuit is further operative to modify the phase of the first output symbol based on the phase of the preceding output symbol.

88. The transmission link of Claim 74, wherein the signal property of the first output symbol is a frequency of the first output signal and the predistortion circuit is further operative to modify the first output symbol by modifying the frequency of the first output symbol.

89. The transmission link of Claim 88, wherein the predistortion circuit is further operative to modify the frequency of the first output symbol based on the frequency of the first output symbol.

90. The transmission link of Claim 88, wherein the predistortion circuit is further operative to modify the frequency of the first output symbol based on the frequency of the preceding output symbol.

91. The transmission link of Claim 88, wherein the predistortion circuit is further operative to modify the frequency of the first output symbol based on the frequency of the succeeding output symbol.

92. The transmission link of Claim 71, further comprising a desymbolizer comprising a photodetector, a post-compensation circuit, and a decoder.

93. The transmission link of Claim 92, wherein the desymbolizer is associated with a receiver functionally connected to the optical fiber, and wherein the desymbolizer is operative to decode the output signal into n output streams, each output stream having a data rate of $1/n$ of the output signal data rate.

94. An optical transmitter for generating an optical fiber communication signal for transmission over an optical fiber, the optical transmitter comprising:

a symbolizer for receiving an input data signal comprising a series of pulses, each pulse having one of two distinct pulse levels, wherein the symbolizer is operative to convert n pulses from the input data signal into an error resistant n-bit output word, and further operative to generate an output symbol representing one of 2^n distinct values; and

an optical source for transmitting an output signal comprising at least one optical symbol over the optical fiber, each optical symbol represented by one of 2^n optical intensity levels; and

wherein the symbolizer further comprises a linearizer circuit operative to introduce a corrective offset into the output signal to counteract a nonlinear response associated with the optical source.

95. The optical transmitter of Claim 94, wherein the input data signal is received from n separate channels, wherein the output signal comprises n-times higher data rate than the n separate channels.

96. The optical transmitter of Claim 94, wherein the input data signal is received from a single channel.

97. The optical transmitter of Claim 94, wherein a drive current controls the optical source.

98. The optical transmitter of Claim 94, wherein the linearizer circuit is further operative to reduce the drive current associated with the output signal by an error current.

99. The optical transmitter of Claim 94, wherein the linearizer circuit comprises a nonlinear element operative to shunt the error current from the drive current.

100. The optical transmitter of Claim 94, wherein the corrective offset comprises a reduction in the drive voltage associated with the output signal by an error voltage.

101. A method for increasing the data throughput of an existing optical fiber communications system without replacing an optical fiber plant associated with the existing optical fiber communications system, the method comprising the steps of:

replacing an existing transmitter with an upgrade transmitter having a symbolizer for receiving an input data signal comprising a series of pulses, each pulse having one of two distinct pulse levels, wherein the symbolizer is operative to convert n pulses from the input data signal into an error resistant n-bit output word, and further operative to generate an output symbol representing one of 2^n distinct values; and, the output symbol representing the n-bit output word; and

replacing an existing receiver with an upgrade receiver having a desymbolizer operative to receive and decode an output signal generated by the upgrade transmitter, the output signal comprising a series of output symbols.

102. The method claim of 101, wherein the symbolizer is further operative to convert each output symbol to an n-bit error protected symbol using error protection coding, and wherein the transmitted output signal comprises n-times higher data rate than a data rate associated with each of the separate input data signals.